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Bodenhamer et al.

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(54) **OPTIMIZATION GUIDED BY CONNECTION CLASSIFICATION IN A WEB BROWSER EXTENSION**

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H04L 29/06	(2006.01)
G06F 17/30	(2006.01)
H04L 29/08	(2006.01)

(52) **U.S. Cl.**
CPC ***H04L 67/42*** (2013.01); ***G06F 17/30899*** (2013.01); ***H04L 67/02*** (2013.01)

(58) **Field of Classification Search**
None
See application file for complete search history.

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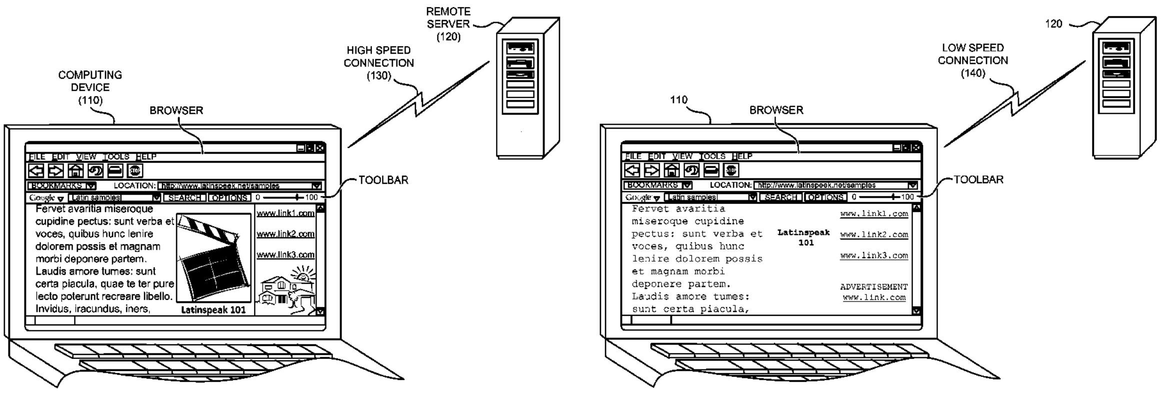
(57) **ABSTRACT**

A client device requests, from a particular server, a document for presentation in a browser associated with the client device, and receives the document. The client device calculates one or more connection performance values for the document and determines whether the one or more connection performance values are below a threshold value. The client device sends, to another server, a request for another document, for presentation in the browser, where the request for the other document includes an indication of whether the one or more connection performance values are below the threshold value. The client device receives a first version of the other document when the connection performance is below the threshold value and receives a second version of the other document when the connection performance is greater than or equal to the threshold value, where the first version includes less rich content than the second version.

25 Claims, 9 Drawing Sheets


REMOTE SERVER (120)
HIGH SPEED CONNECTION (130)
COMPUTING DEVICE (110)
BROWSER
TOOLBAR
FILE EDIT VIEW TOOLS HELP
BOOKMARKS
LOCATION: http://www.latinspeak.net/samples
Google
Latin samples
SEARCH
OPTIONS
0
100
Fervet avaritia miseroque cupidine pectus: sunt verba et voces, quibus hunc lenire dolorem possis et magnam morbi deponere partem. Laudis amore tumes: sunt certa piacula, quae te ter pure lecto poterunt recreare libello. Invidus, iracundus, iners,
Latinspeak 101
www.link1.com
www.link2.com
www.link3.com
120
LOW SPEED CONNECTION (140)
110
BROWSER
TOOLBAR
FILE EDIT VIEW TOOLS HELP
BOOKMARKS
LOCATION: http://www.latinspeak.net/samples
Google
Latin samples
SEARCH
OPTIONS
0
100
Fervet avaritia miseroque cupidine pectus: sunt verba et voces, quibus hunc lenire dolorem possis et magnam morbi deponere partem. Laudis amore tumes: sunt certa piacula,
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www.link1.com
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www.link3.com
ADVERTISEMENT
www.link.com

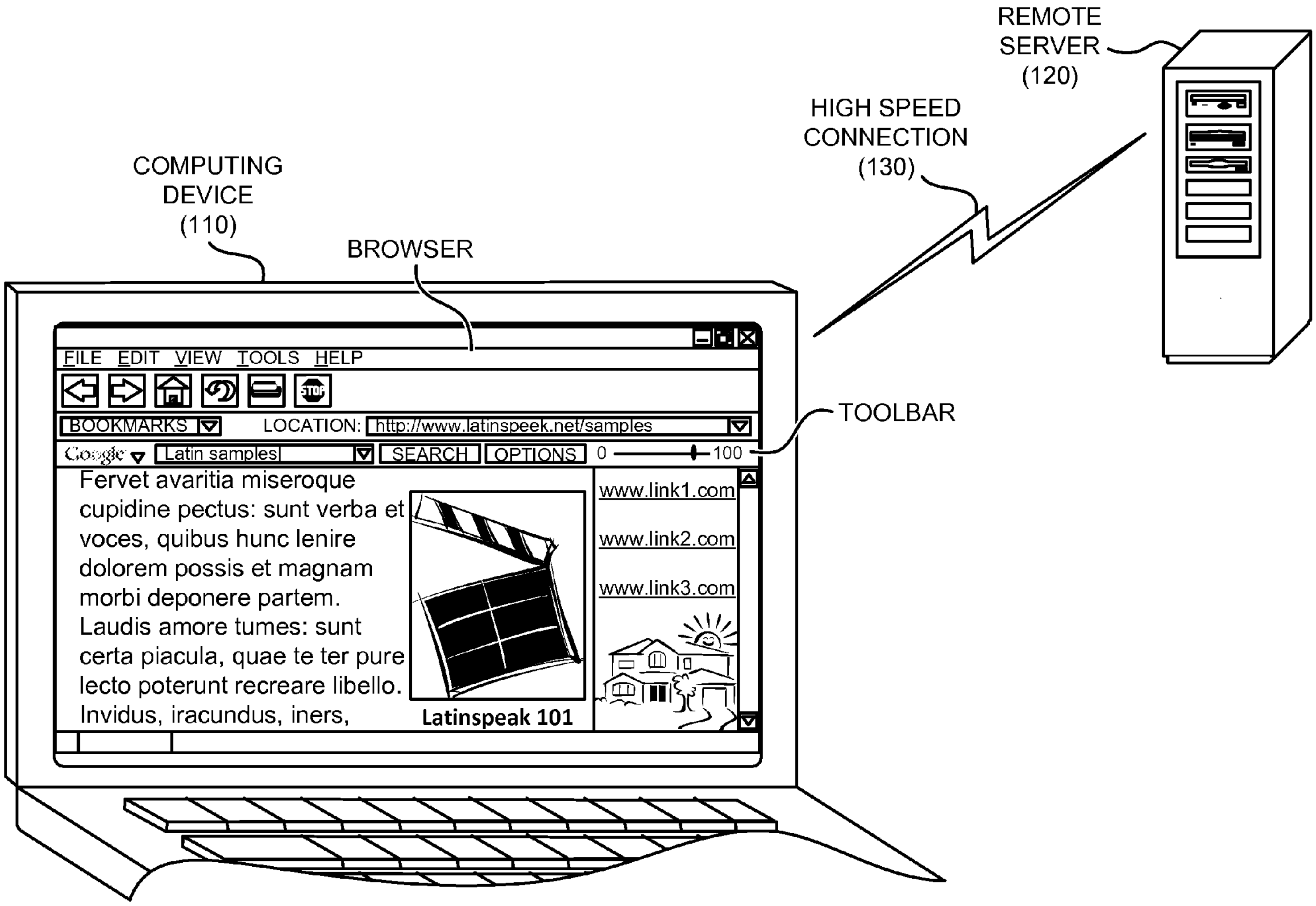

REMOTE SERVER (120)
HIGH SPEED CONNECTION (130)
COMPUTING DEVICE (110)
BROWSER
TOOLBAR
FILE EDIT VIEW TOOLS HELP
STOP
BOOKMARKS
LOCATION: http://www.latinspeek.net/samples
Google
Latin samples
SEARCH
OPTIONS
0
100
Fervet avaritia miseroque cupidine pectus: sunt verba et voces, quibus hunc lenire dolorem possis et magnam morbi deponere partem. Laudis amore tumes: sunt certa piacula, quae te ter pure lecto poterunt recreare libello. Invidus, iracundus, iners,
Latinspeak 101
www.link1.com
www.link2.com
www.link3.com

FIG. 1A

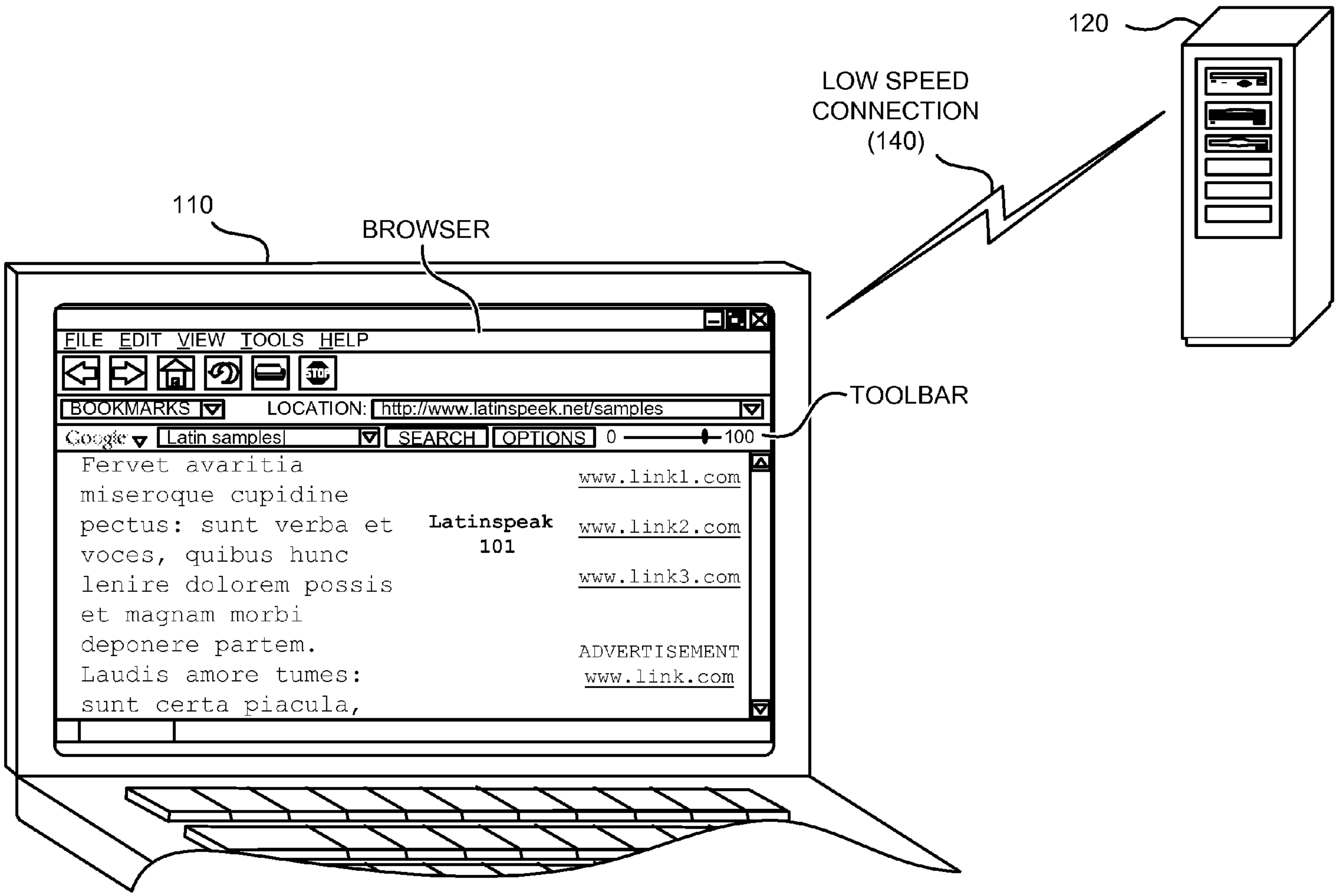

120
LOW SPEED
CONNECTION
(140)
110
BROWSER
TOOLBAR
FILE EDIT VIEW TOOLS HELP
BOOKMARKS
LOCATION: http://www.latinspeek.net/samples
Google
Latin samples
SEARCH
OPTIONS
0
100
Fervet avaritia
miseroque cupidine
pectus: sunt verba et
voces, quibus hunc
lenire dolorem possis
et magnam morbi
deponere partem.
Laudis amore tumes:
sunt certa piacula,
Latinspeak
101
www.link1.com
www.link2.com
www.link3.com
ADVERTISEMENT
www.link.com

FIG. 1B

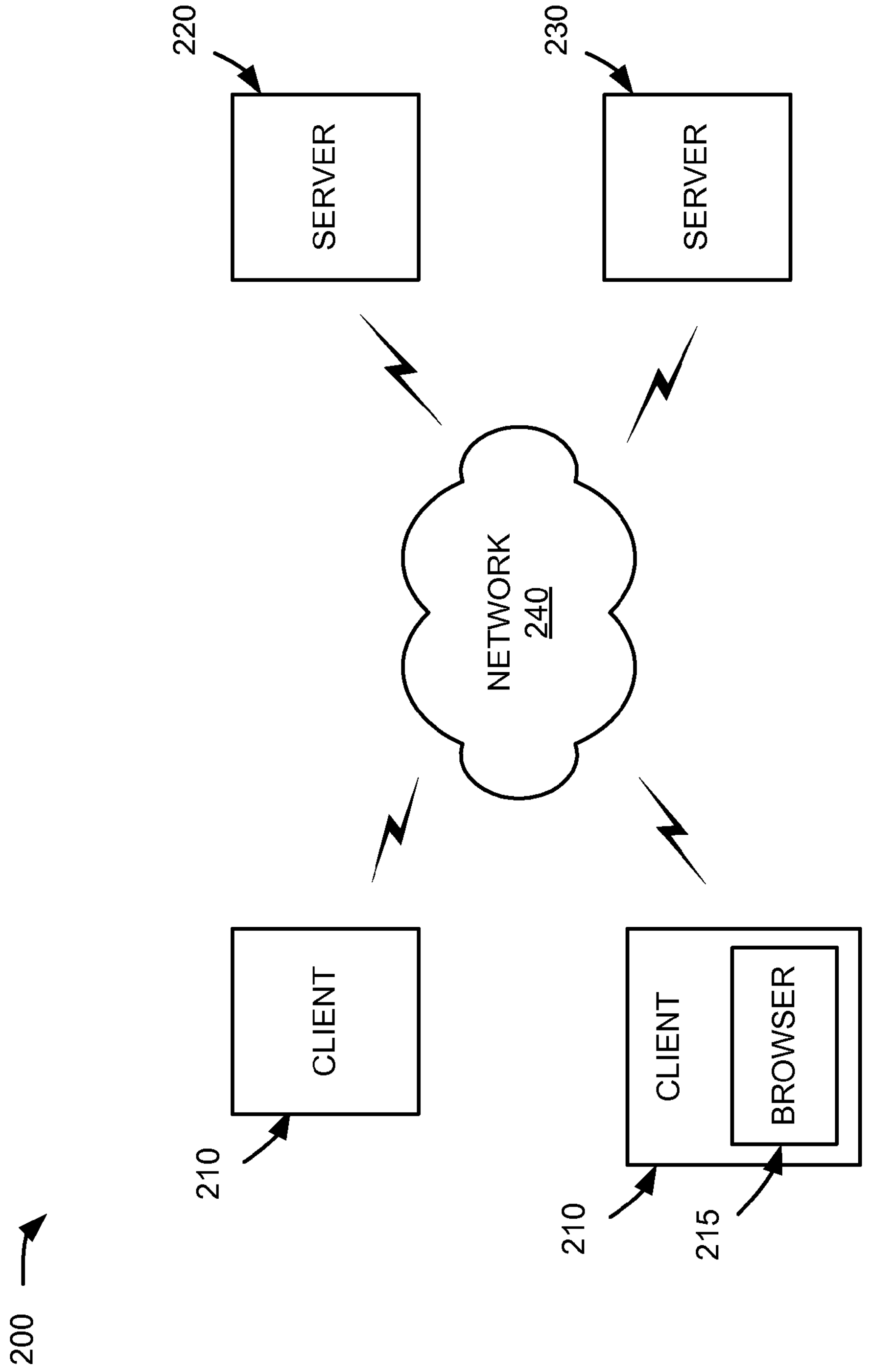

200
210
CLIENT
210
215
CLIENT
BROWSER
NETWORK
240
220
SERVER
230
SERVER

FIG. 2

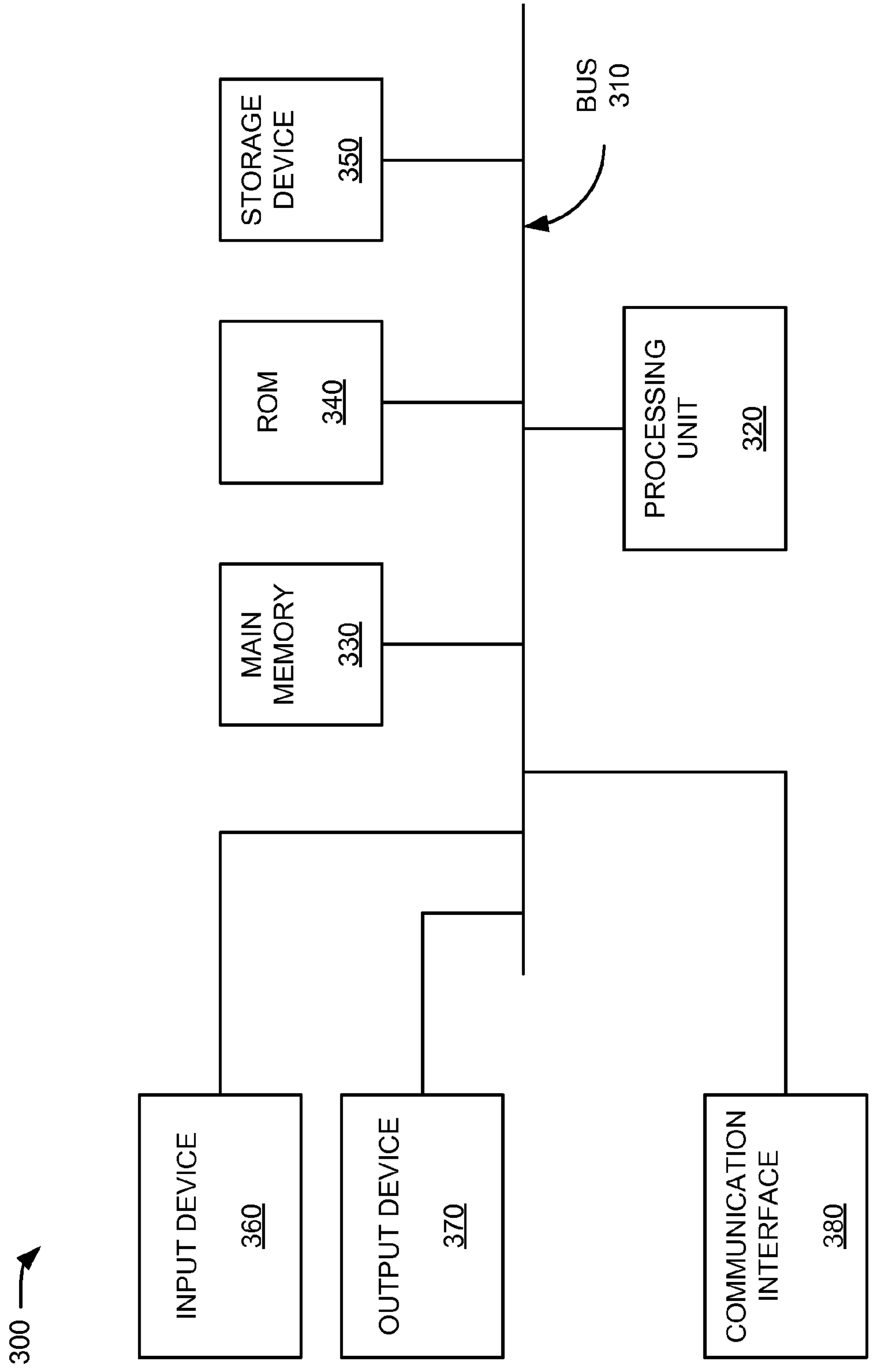

300
STORAGE DEVICE 350
ROM 340
MAIN MEMORY 330
BUS 310
PROCESSING UNIT 320
INPUT DEVICE 360
OUTPUT DEVICE 370
COMMUNICATION INTERFACE 380

FIG. 3

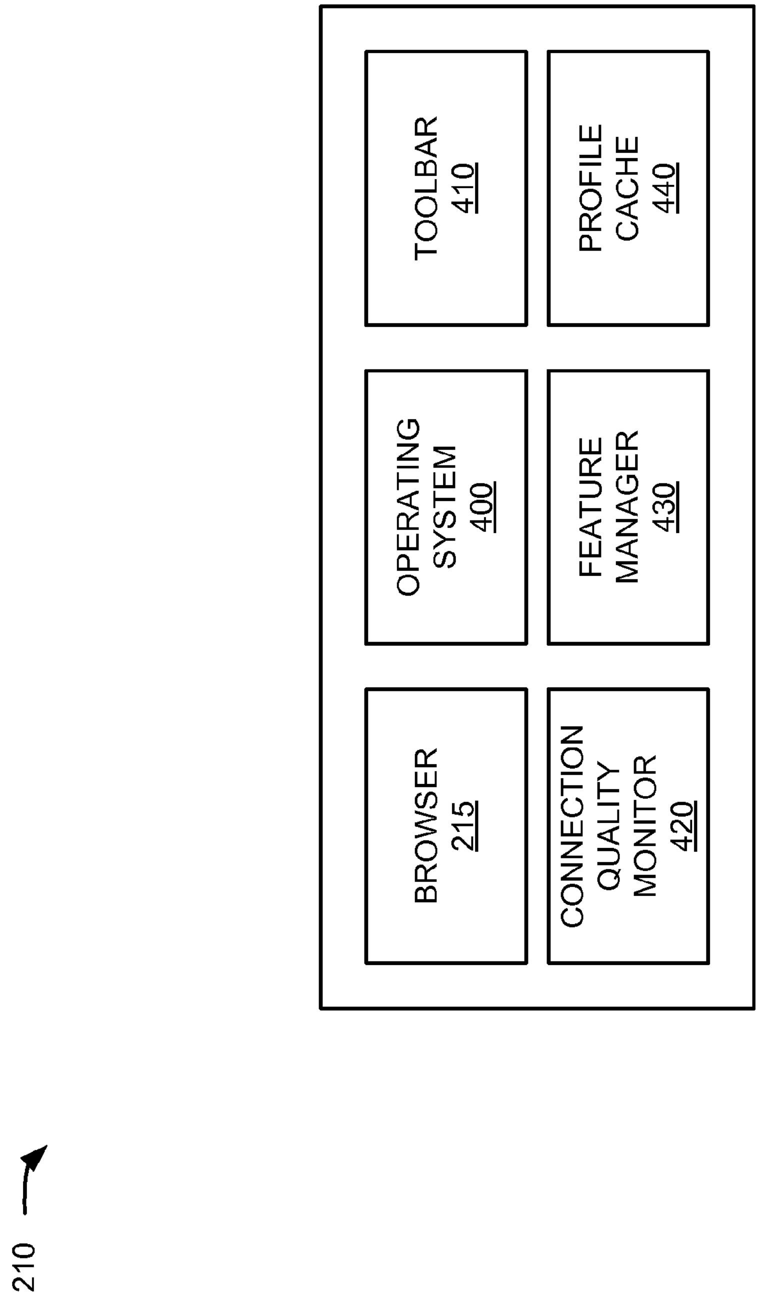
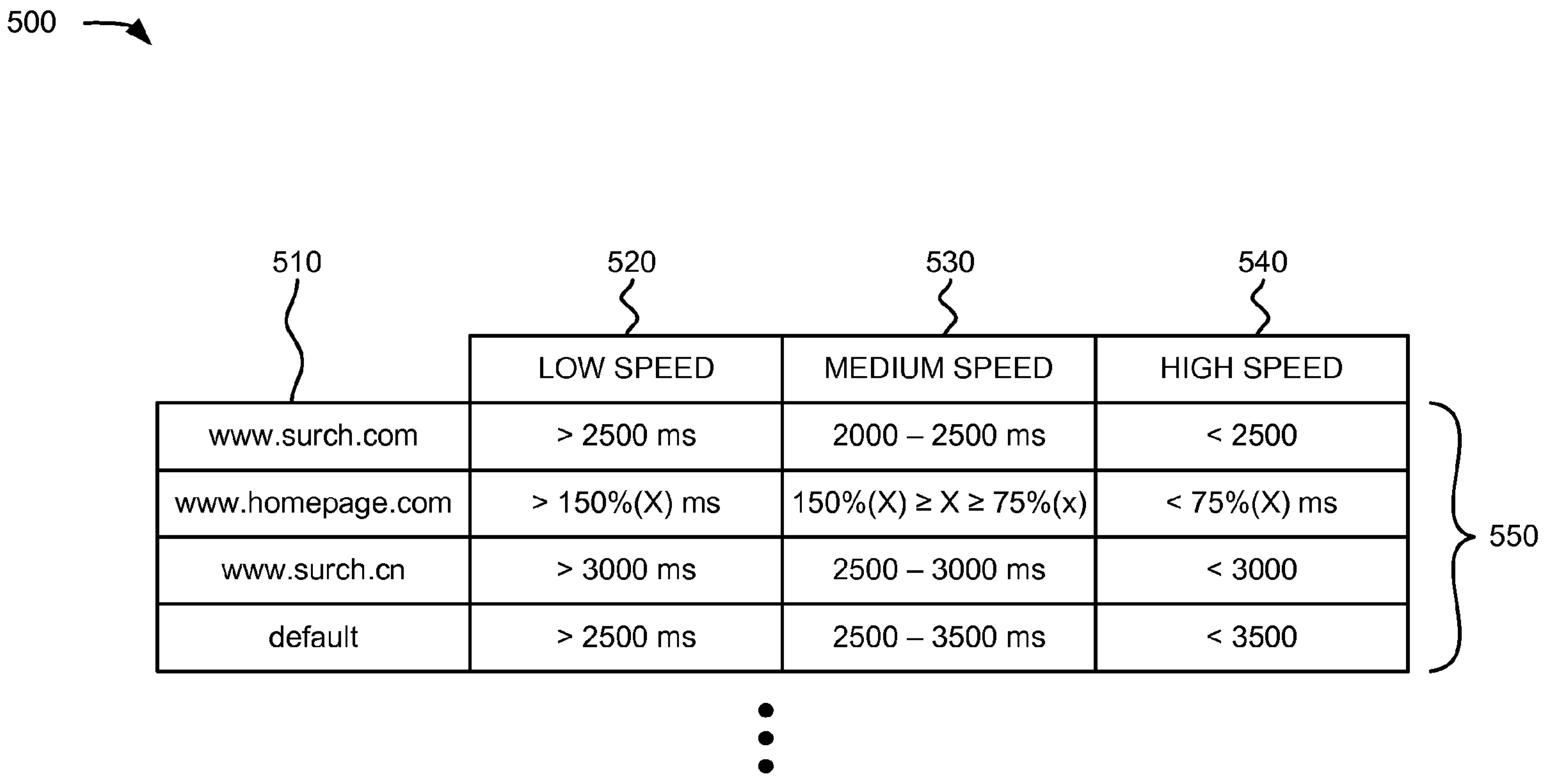

210
BROWSER 215
OPERATING SYSTEM 400
TOOLBAR 410
CONNECTION QUALITY MONITOR 420
FEATURE MANAGER 430
PROFILE CACHE 440

FIG. 4


500
510
520
530
540
550

	LOW SPEED	MEDIUM SPEED	HIGH SPEED
www.surch.com	> 2500 ms	2000 – 2500 ms	< 2500
www.homepage.com	> 150%(X) ms	150%(X) ≥ X ≥ 75%(x)	< 75%(X) ms
www.surch.cn	> 3000 ms	2500 – 3000 ms	< 3000
default	> 2500 ms	2500 – 3500 ms	< 3500

⋮

FIG. 5

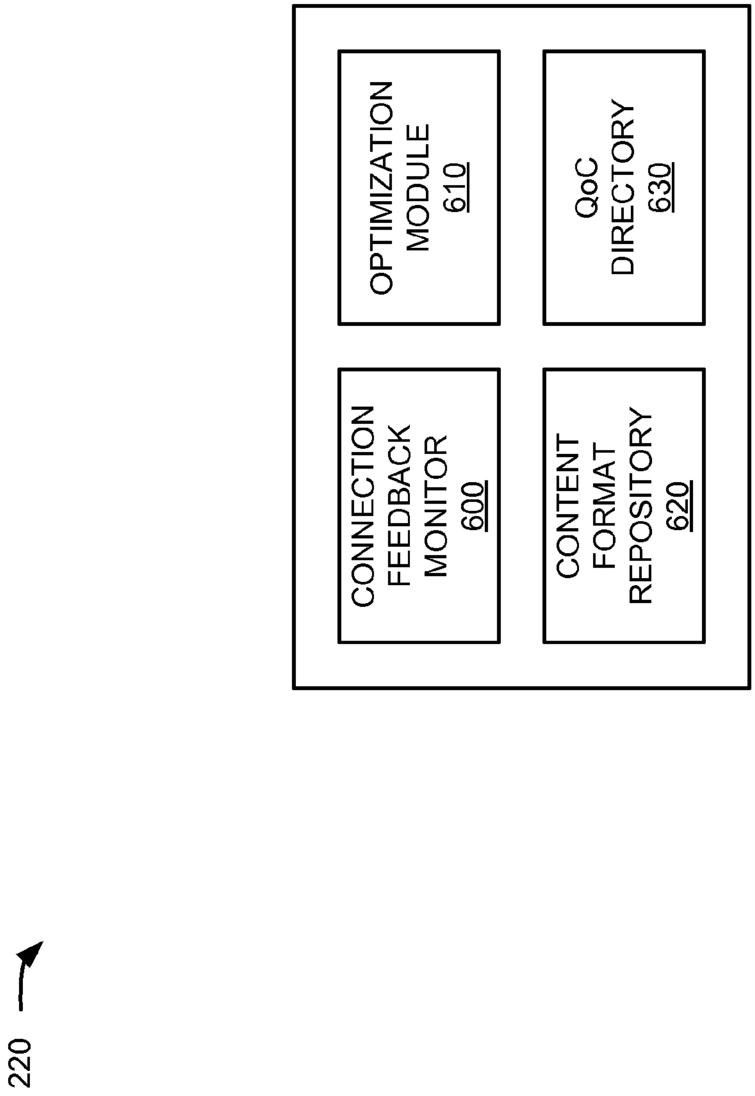

220
CONNECTION FEEDBACK MONITOR 600
OPTIMIZATION MODULE 610
CONTENT FORMAT REPOSITORY 620
QoC DIRECTORY 630

FIG. 6

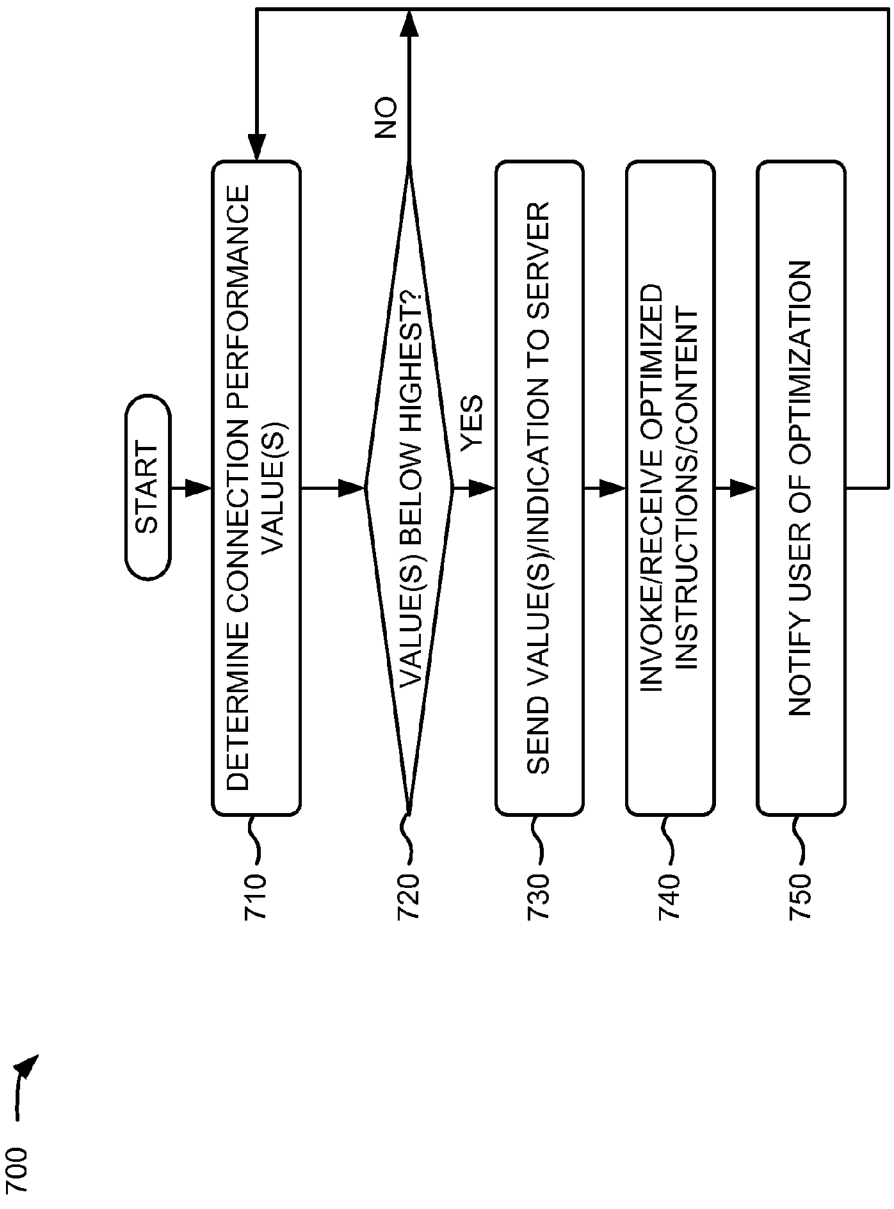

700
START
710
DETERMINE CONNECTION PERFORMANCE VALUE(S)
720
VALUE(S) BELOW HIGHEST?
NO
YES
730
SEND VALUE(S)/INDICATION TO SERVER
740
INVOKE/RECEIVE OPTIMIZED INSTRUCTIONS/CONTENT
750
NOTIFY USER OF OPTIMIZATION

FIG. 7

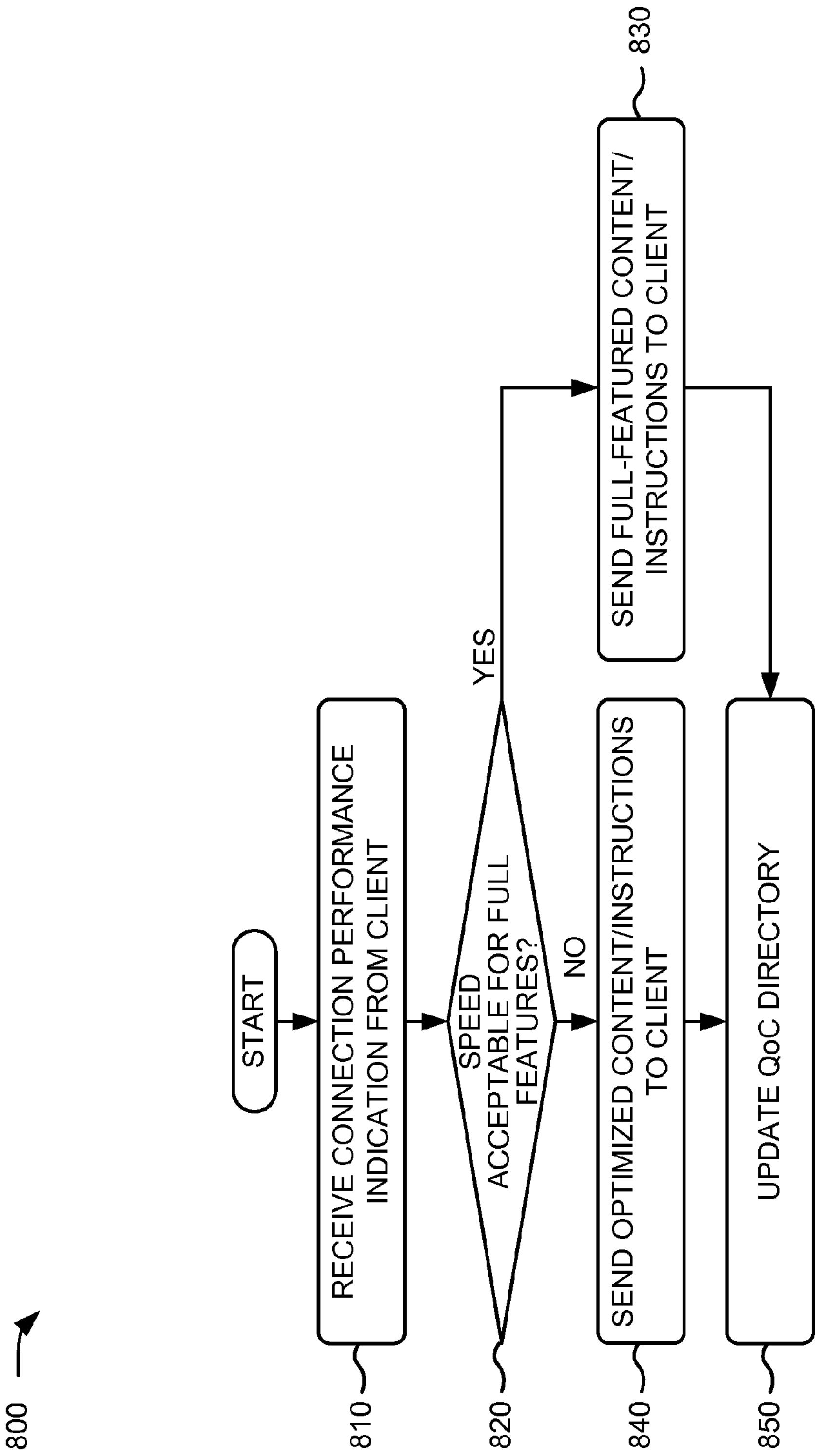

800
START
810
RECEIVE CONNECTION PERFORMANCE INDICATION FROM CLIENT
820
SPEED ACCEPTABLE FOR FULL FEATURES?
YES
NO
830
SEND FULL-FEATURED CONTENT/ INSTRUCTIONS TO CLIENT
840
SEND OPTIMIZED CONTENT/INSTRUCTIONS TO CLIENT
850
UPDATE QoC DIRECTORY

FIG. 8

OPTIMIZATION GUIDED BY CONNECTION CLASSIFICATION IN A WEB BROWSER EXTENSION

BACKGROUND

Many companies currently offer web browser extensions. Browser extensions, such as toolbars, may be included to improve the user interface for the web browser and/or other applications. These browser extensions provide functionality that is not available in existing applications. For example, a toolbar for a web browser may permit a user to perform a search right from the toolbar, permit terms to be highlighted on a web page, provide pop-up protection, and do other things to assist the user in finding information of interest. Web browser extensions may also include performance optimizations to improve the user's experience of the web browser.

When a user connects to a website, that website (or web server) knows little about the performance characteristics of the user device to which the server is connecting. Thus, the web server must serve a "one size fits all" web page which may result in long page load times (PLTs) or other delays for users with low quality connections.

SUMMARY

According to one aspect, a method, performed by a client device, may include requesting, by the client device and from a particular server, documents for presentation in a browser associated with the client device; receiving, by the client device and from the particular server, the documents; calculating, by a processor of the client device, one or more connection performance values for the documents; determining, by the processor of the client device, whether the one or more connection performance values are below a threshold value; sending, by the client device and to another server, a request for another document, for presentation in the browser, where the request for the other document includes an indication of whether the one or more connection performance values are below the threshold value; receiving a first version of the other document when the one or more connection performance values are below the threshold value; and receiving a second version of the other document when the one or more connection performance values are greater than or equal to the threshold value, where the first version includes less rich content than the second version.

According to another aspect, a method, performed by one or more server devices, may include receiving, by one of the one or more server devices and from a client, a request for a particular document, where the request includes a connection performance indication for the client; determining, by one of the one or more server devices and in response to the request, if the connection performance indication is sufficient for providing full-featured services; sending, one of the one or more server devices and to the client, the particular document with rich content when the connection performance indication is sufficient for providing full-featured services; and sending, by one of the one or more server devices and to the client, the particular document in an optimized format when the connection performance indication is not sufficient for providing full-featured services, where the optimized format includes less rich content than the particular document with rich content.

According to a further aspect, a computer-readable medium may store computer-executable instructions. The instructions may include an instruction to calculate a page load time (PLT) value for a document provided to a client device; an instruction to determine, based on the determined PLT value, a qualitative connection performance indicator for the client device; and an instruction to send, to a server, a request for another document, where the request includes the qualitative connection performance indicator; an instruction to receive a first version of the other document when the qualitative connection performance indicator corresponds to a first connection quality; and an instruction to receive a second version of the other document when the qualitative connection performance indicator corresponds to a second connection quality, where the first version includes less rich content than the second version.

According to still another aspect, a system having one or more server devices may include a memory, to store instructions, and a processor. The processor may execute instructions in the memory to receive, from a client, a request for a particular document, where the request includes a connection performance indication for the client, determine if the connection performance indication is sufficient for providing full-featured services, send, to the client, the particular document with rich content when the connection performance indication is sufficient for providing full-featured services, and send, to the client, the particular document in an optimized format, including less rich content than the particular document with rich content, when the connection performance indication is not sufficient for providing full-featured services, where the optimized format includes a notification, for presentation to a user of the client, of the optimized format.

According to yet another aspect, a method, performed by a client device, may include requesting, by the client device and from a particular server, a document for presentation in a browser associated with the client device; receiving, by the client device and from the particular server, the document; calculating, by a processor of the client device, one or more connection performance values for the document; determining, by the processor of the client device, whether the one or more connection performance values are below a threshold value; and adjusting, by the processor of the client device, features associated with the browser or a browser extension, associated with the browser, based on the determining whether the one or more connection performance values are below the threshold value.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate one or more embodiments described herein and, together with the description, explain the these embodiments. In the drawings:

FIGS. **1**A and **1**B are diagrams illustrating a concept described herein;

FIG. **2** is a diagram of an example network in which systems and/or methods described herein may be implemented;

FIG. **3** is a diagram of an example client or server of FIG. **2**;

FIG. **4** is a block diagram of example functional components of a client of FIG. **2**;

FIG. **5** is a diagram of an example format for a data structure that may be used to classify connection performance;

FIG. **6** is a block diagram of example functional components of a server of FIG. **2**;

FIG. **7** is a flowchart of an example process for optimizing browser performance based on a connection performance; and

FIG. **8** is a flowchart of an example process for providing optimized browser content based on a connection performance.

DETAILED DESCRIPTION

The following detailed description refers to the accompanying drawings. The same reference numbers in different drawings may identify the same or similar elements. Also, the following detailed description does not limit the invention.

Overview

Systems and/or methods described herein may implement a browser or browser extension to monitor the performance of a client's network connection. Based on the monitored connection performance, the browser or browser extension may automatically adjust settings of the browser or browser extension to improve performance (e.g., of other features provide by the browser extension). Additionally, or alternatively, systems and/or methods described herein may transmit indications of the monitored connection performance to servers that provide documents (e.g., web pages) to the client.

In one implementation, the browser extension may cause the browser to attach performance information to a document request sent to a server. Based on the performance information in the document request, the server may adjust its content format to best meet the current local connection performance of the client's network connection. For example, the server may provide a high quality document (e.g., in a rich format with bandwidth-intensive content, such as images, video and audio) or a low quality documents (e.g., optimized for less bandwidth consumption) based on the local connection performance of the client's network connection.

A "browser extension" as the term is used herein, may be broadly interpreted to include application software that may be integrated with base application software to enhance the base application software. For example, a browser extension may provide increased specialization or customization for a particular use. A "module," as the term is used herein, may be broadly construed to include a feature of a browser extension. A "base application," as the term is used herein, may be broadly construed to include an application into which an add-on application, such as a browser extension, is integrated or associated.

A "document," as the term is used herein, is to be broadly interpreted to include any machine-readable and machine-storable work product. A document may include, for example, an e-mail, a web page or a web site, a file, a combination of files, one or more files with embedded links to other files, a news group posting, a news article, a blog, a business listing, an electronic version of printed text, a web advertisement, etc. In the context of the Internet (i.e., the web), a common document is a web page. Documents often include textual information and may include embedded information (such as meta information, images, hyperlinks, etc.) and/or embedded instructions (such as Javascript, etc.).

While systems and/or methods are described herein primarily in the context of a web browser with a distinct browser extension, in other implementations, the systems and/or methods may be used with only a web browser (or another application) that implements features of a web browser extension described herein.

FIGS. **1**A and **1**B are diagrams illustrating a concept described herein. Referring collectively to FIGS. **1**A and **1**B, a user might use a computing device **110** to run an application, such as a browser. The browser may include a browser extension, such as a user interface toolbar, that provides additional functionality to a base application, such as the browser. The additional functionality may be provided within the toolbar. For example, the toolbar may include features that allow a user to check spelling within web-page forms, highlight search terms within a web-page, provide a suggestion window for typed search terms, translate text on web pages, rank popularity of search results, etc. Some or all features of the toolbar may depend on sending data to and/or receiving data from a remote server **120**. Also, some or all of the features of the toolbar may be logically separated as individual modules that may be selectively enabled/disabled to provide optimal performance for different network connection qualities.

As shown in FIG. **1**A, computing device **110** may connect to remote server **120** using a high-speed network connection **130**. Generally, high-speed network connection **130** may provide computing device **110** with a high bandwidth connection (e.g., a connection speed greater than a particular threshold) to access remote server **120**. High-speed network connection **130** may allow, for example, the toolbar to send data to and/or receive data from remote server **120**, in a manner that allows the browser and the toolbar to provide all available features of the toolbar and of any requested document with minimal latency.

Referring to FIG. **1**B, computing device **110** may, at a different time and/or location, connect to remote server **120** using a low-speed network connection **140**. Generally, low-speed network connection **140** may provide computing device **110** with a lower bandwidth connection (e.g., compared to high-speed network connection **130**) to access remote server **120**. In contrast with high-speed network connection **130**, use of all available features of the browser and the toolbar over low-speed network connection **140** may result in noticeable performance degradation, such as high latency and/or long document load times.

In an implementation described herein, the toolbar may detect low quality connections, such as low-speed network connection **140**, and disable particular features of the toolbar to preempt high latency and/or long document load times. Furthermore, the toolbar may provide connection performance information (e.g., along with a document request) to remote server **120** or a different server (not shown). The connection performance information may allow the remote server **120** to adjust the format of the requested document to best match the current connection performance, without, for example, having to first make the user wait to load a document with rich content over a slow connection. As shown in the example of FIGS. **1**A and **1**B, a web page presented in a rich format in FIG. **1**A (e.g., with a high-speed connection) may be provided as a non-rich format (e.g., a text-only format) in FIG. **1**B (e.g., with a low-speed connection). Thus, remote server **120** may provide content in a format optimized for the client's current connection performance without first having to first provide a poor user experience to identify a slow connection.

The implementation of the toolbar in the browser, shown in FIGS. **1**A and **1**B, is an illustrative example. In other implementations, systems and/or methods described herein may be applied to other browser extensions and/or base applications to optimize performance based on a network connection performance. For example, features described herein as attributable to a browser extension may also be integrated into a web browser.

Example Network Configuration

FIG. **2** is a diagram of an example network **200** in which systems and/or methods described herein may be implemented. Network **200** may include multiple clients **210** connected to multiple servers **220** and **230** via a network **240**. Two clients **210** and two servers **220** and **230** have been illustrated as connected to network **240** for simplicity. In practice, there may be more or fewer clients **210** and servers **220** and **230**. Also, in some instances, a client may perform a function of a server or a server may perform a function of a client.

Client **210** may include a client device such as a personal computer (e.g., computing device **110**), a wireless telephone, a personal digital assistant (PDA), a lap top, or another type of computation or communication device. In one implementation, a client **210** may include a browser **215**. Browser **215** may permit a user to access documents and may provide an interface to servers **220** and **230**. Browser **215** may include a browser extension (also referred to herein as a "browser assistant") that may take the form of an add-on toolbar or some other functionality that may operate separate from or in conjunction with browser **215**. In other words, browser **215** may perform the functions described below as being performed by the browser assistant. In another implementation, the browser assistant may be integrated as part of browser **215**. In some situations, the browser assistant may operate as an interface between browser **215** and network **240**.

Servers **220** and **230** may include server devices that gather, process, search, and/or maintain documents. In one implementation, server **220** may receive, respond to, and/or redirect requests, from clients **210**, for browser **215** and/or the browser assistant. As described in detail below, server **220** may provide to clients **210** content and/or instructions that may be optimized based on particular connection speeds experienced by clients **210**. Server **230** may store or maintain documents that may be accessed by clients **210**. Such documents may include data related to news stories, products, images, user groups, geographic areas, or any other type of data. In one implementation, server **220** and server **230** may supply documents with similar content in different formats, based on particular connection speeds reported by clients **210**.

While servers **220** and **230** are shown as separate entities, it may be possible for one of server **220** or **230** to perform one or more of the functions of the other one of server **220** or **230**. For example, it may be possible for both servers **220** and **230** to be implemented as a single server. It may also be possible for a single one of server **220** or **230** to be implemented as two or more separate (and possibly distributed) devices.

Network **240** may include a local area network (LAN), a wide area network (WAN), a telephone network, such as the Public Switched Telephone Network (PSTN) or a cellular network, an intranet, the Internet, or a combination of networks. Clients **210** and servers **220**/**230** may connect to network **240** via wired and/or wireless connections.

Although FIG. **2** shows example devices of network **200**, in other implementations, network **200** may contain fewer devices, different devices, differently arranged devices, or additional devices than depicted in FIG. **2**. Alternatively, or additionally, one or more devices of network **200** may perform one or more other tasks described as being performed by one or more other devices of network **200**.

Example Components of Client/Server

FIG. **3** is a diagram of example components of a device **300** that may correspond to one or more of client **210**, server **220**, and/or server **230**. The device **300** may include a bus **310**, a processing unit **320**, a main memory **330**, a read only memory (ROM) **340**, a storage device **350**, an input device **360**, an output device **370**, and a communication interface **380**. Bus **310** may include a path that permits communication among the components of device **300**.

Processing unit **320** may include a processor, microprocessor, or processing logic that interprets and executes instructions. Main memory **330** may include a random access memory (RAM) or another type of dynamic storage device that stores information and/or instructions for execution by processor **320**. ROM **340** may include a ROM device or another type of static storage device that stores static information and instructions for use by processor **320**. Storage device **350** may include a magnetic and/or optical recording medium and its corresponding drive.

Input device **360** may include a mechanism that permits an operator to input information to the device **300**, such as a keyboard, a mouse, a pen, voice recognition and/or biometric mechanisms, etc. Output device **370** may include a mechanism that outputs information to the operator, including a display, a button, a speaker, etc. Communication interface **380** may include any transceiver-like mechanism that enables device **300** to communicate with other devices and/or systems. For example, communication interface **380** may include mechanisms for communicating with another device or system via a network, such as network **230**.

As described herein, device **300** may perform certain operations in response to processing unit **320** executing software instructions contained in a computer-readable medium, such as main memory **330**. A computer-readable medium may be defined as a physical or logical memory device. A logical memory device may include memory space within a single physical memory device or spread across multiple physical memory devices. The software instructions may be read into main memory **330** from another computer-readable medium or from another device via communication interface **380**. The software instructions contained in main memory **330** may cause processing unit **320** to perform processes described herein. Alternatively, hardwired circuitry may be used in place of or in combination with software instructions to implement processes described herein. Thus, implementations described herein are not limited to any specific combination of hardware circuitry and software.

Although FIG. **3** shows example components of device **300**, in other implementations, device **300** may contain fewer components, different components, differently arranged components, or additional components than depicted in FIG. **3**. Alternatively, or additionally, one or more components of device **300** may perform one or more other tasks described as being performed by one or more other components of device **300**.

FIG. **4** is a block diagram of example functional components of client **210**. The functional blocks illustrated in FIG. **4** may be implemented in hardware or a combination of software and hardware on client **210**. For example, the functional components described in connection with FIG. **4** may be implemented by one or more of the components depicted in FIG. **3**. While particular functional blocks are shown as being associated with client **210**, any of these functional blocks may be implemented in client **210** or a combination of client **210** and server **220**/**230**. As shown in FIG. **4**, client **210** may include browser **215**, an operating system **400**, a toolbar **410**, a connection quality monitor **420**, a feature manager **430**, and a profile cache **440**.

Browser **215** may include features described above in connection with, for example, FIG. **2**. For example, browser **215** may include software associated with a web browser, such as the Microsoft® Internet Explorer, Google® Chrome, Netscape Navigator, Apple® Safari, or Mozilla® Firefox®

browser. Operating system **400** may include operating system software, such as the Windows®, Unix®, Mac™ OS, or Linux® operating systems.

Toolbar **410** may include a browser extension, such as a plug-in, an applet, a dynamic link library (DLL), a bookmark, or a similar executable object or process. Client **210** may obtain the executable object or process from a server, such as one of servers **220** and **230**, or from a third party, such as a third party server, disk, tape, network, CD-ROM, etc. Alternatively, the executable object or process may be pre-installed on client **210** (e.g., by a vendor or an original equipment manufacturer (OEM)). Toolbar **410** may be presented as a user interface object within a web browser window (e.g., of browser **215**). The user interface object may operate in conjunction with the web browser. In another implementation, toolbar **410** may be part of the web browser. In this latter implementation, the web browser may perform the functions of the user interface object. In yet another implementation, the user interface object may be a process separate from the web browser. For example, the user interface object may interface between the web browser and network **240**. Toolbar **410** may be automatically activated upon initiation of the web browser. Alternatively, toolbar **410** may be activated when instructed by a user. In either case, toolbar **410** may take the form of a user interface object, as described above.

Toolbar **410** may include a variety of features to provide increased specialization or customization for particular uses. For example, toolbar **410** may include features that allow a user to check spelling within document forms, highlight search terms within a document, provide a suggestion window for typed search terms, translate text within documents, etc. Some or all features of toolbar **410** may be logically separated as individual modules that may be turned on/of without affecting other features of toolbar **410**.

Connection quality monitor **420** may measure connection performance indicators for requested documents (e.g., web pages). Connection performance indicators for a client (e.g., client **210**) may include, for example, PLTs, processor speed, available RAM values, a number of cache evictions, etc.

In one implementation, PLTs may be used as indicators of connection performance. For example, short PLTs may be indicative of fast or adequate connection performance, while longer PLTs (e.g., PLTs greater than a particular threshold) for the same document (or all documents generally) may be indicative of slower or inadequate connection performance. PLT measurements may be split into multiple components, such as latency (e.g., domain name system (DNS) latency, TCP/IP connection latency, etc.), bandwidth, page render time, etc. Latency may generally be measured as the time period from when a user selects a link from browser **215** to when the document starts to load. Latency may include subcomponents such as DNS latency (e.g., look-up time), TCP/IP connection latency, etc. A connection could, for example, have poor latency and good bandwidth (e.g., a satellite connection) or good latency and poor bandwidth (e.g., a modem). Thus, in one implementation, connection quality monitor **420** may identify separate components (e.g., latency, bandwidth, etc.) of PLT measurements.

PLTs may be measured from the perspective of client **210** (e.g., based on timestamps obtained from operating system **400**). Connection quality monitor **420** may, for example, implement a local stopwatch script to detect start times and end times for latency, page-render times, and/or total load time of requested documents (e.g., web pages). In other implementations, connection quality monitor **420** may obtain connection performance information from another component of client **210**, such as another module associated with browser **215**.

In another implementation, connection quality monitor **420** may identify PLTs for particular benchmark documents. Benchmark documents may include one or more documents with known preferred (or maximum acceptable) page load times, as defined, for instance, by the document originator. For example, connection quality monitor **420** may store a list of benchmark documents that includes a URL and a threshold PLT associated with each URL. Stored PLTs, from the list of benchmark documents, may be compared against actual PLTs for requested benchmark documents (e.g., web pages) to determine if a current local network connection performance (e.g., between client **210** and server **220/230**) provides expected performance.

In one implementation, connection quality monitor **420** may identify connection performance indicators (e.g., PLTs, PLT components, processor speed, available RAM, cache evictions, etc.) for multiple document requests to determine an average connection performance value. The average connection performance value may be calculated, for example, as a moving average (e.g., a weighted or non-weighted average of a particular number of most recent documents) or a periodic average (e.g., an average calculated at certain intervals). The average connection performance value may be compared against stored threshold values to determine if a current network connection quality (e.g., between client **210** and server **220/230**) provides expected performance.

In one implementation, connection quality monitor **420** may report connection performance data (e.g., PLT values, processor speed, available RAM, cache evictions, etc) for each document requested by client **210**. Additionally, or alternatively, connection quality monitor **420** may collect connection performance data over a particular time period and/or a particular number of downloads (e.g., document downloads) and report an average connection performance value.

In one implementation, connection quality monitor **420** may convert measured connection performance data to qualitative connection performance indicators (e.g., slow/acceptable, low/medium/high, etc.). The qualitative connection performance indicators may, for example, correspond to different optimization levels used by toolbar **410** and/or servers **220/230**. Connection quality monitor **420** may apply qualitative connection performance indicators to each measured connection performance indicator and/or to the averaged connection performance values. Qualitative connection performance indicators are described further below in connection with, for example, FIG. **5**.

Feature manager **430** may manage the functionality of some or all features of toolbar **410** based on connection performance data and/or qualitative connection performance indicators reported by connection quality monitor **420**. Feature manager **430** may also report connection performance data to other devices (e.g., servers **220/230**). In one implementation, feature manager **430** may receive local connection performance data (e.g., PLTs and/or qualitative connection performance indicators) from connection quality monitor **420**. Based on stored instructions, feature manager **430** may enable/disable particular modules of toolbar **410** depending on the local connection performance data. Feature manager **430** may, for example, disable modules of toolbar **410** that require frequent automated communications between client **210** and servers **220/230**. Additionally, or alternatively, feature manager **430** may pause or limit automated communications, from client **210** to servers **220/230**, until an indication of a high-speed connection is received. In one example, automatic updates for toolbar **410** may be temporarily suspended until local connection performance has improved. In another example, preloads of anticipated next web pages (e.g., pages a user may visit based on, for example, the current web page and known user tendencies) may be suspended.

Feature manager **430** may send raw connection performance data, averaged connection performance values, and/or qualitative connection performance indicators to servers **220**/**230**. The connection performance data (e.g., the raw connection performance data, averaged connection performance values, and/or qualitative connection performance indicators) may be sent using existing communication mechanisms associated with toolbar **410**, such as headers or URL parameters associated with a subsequent document request.

In another implementation, feature manager **430** may make a local determination of whether the connection performance data and/or the qualitative connection speed indicators are indicative of a need for optimization. For example, if feature manager **430** determines that the raw connection performance data or the average connection performance data is not above a particular speed threshold, feature manager **430** may not send an indication to server **220** or server **230** and may simply continue to monitor future connection performance. If feature manager **430** determines that the raw connection performance data or the average connection performance data is below a particular speed threshold (or within a range for a particular qualitative connection performance indicator), feature manager **430** may send an indication to server **220** and/or server **230** that optimization is required for a high latency/low bandwidth connection.

Profile cache **440** may store known settings for location profiles associated with client **210**. For example, a user may have multiple wireless location profiles (e.g., for a home, an office, a friend's house, etc.) that tend to have consistent connection performance. In one implementation, feature manager **430** may associate optimization settings with particular location profiles based on previously obtained connection speeds for the particular location profiles. Optimization settings may include, for example, turning on/off features of toolbar **410** to reduce bandwidth usage by browser **215** and/or toolbar **410**. Profile cache **440** may also include customized user preferences, such as overrides of particular optimizations (e.g., particular features that a user prefers even when PLT times indicate a low speed connection).

In an implementation described herein, when feature manager **430** provides an indication to server **220**/**230** that the connection performance for client **210** is not ideal, server **220**/**230** may respond with optimized content and/or instructions to make best use of limited bandwidth. Browser **215** may receive the optimized content and/or instructions and seamlessly implement the optimized content. Server **220**/**230** (or a functional component of client **210**) may provide a message for presentation to the user explaining the temporary change. Additionally, or alternatively, server **220** may provide instructions to feature manager **430** to disable particular modules of toolbar **410** based on the current connection performance.

Although FIG. **4** shows example functional components of client **210**, in other implementations, client **210** may contain fewer functional components, different functional components, differently arranged functional components, or additional functional components than depicted in FIG. **4**. Alternatively, or additionally, one or more functional components of client **210** may perform one or more other tasks described as being performed by one or more other functional components of client **210**.

FIG. **5** provides an example format for a data structure **500** that may be use to classify connection performance. Data structure **500** may be stored, for example, in memory **330** of device **300**. As shown in FIG. **5**, data structure **500** may include multiple entries **510**, with each entry **510** having associated qualitative speed fields (e.g., low speed field **520**, medium speed field **530**, high speed field **540**) and values **550** associated with each speed field.

Each entry **510** may include a document identifier, such as a unique identifier (e.g., a uniform resource locator (URL)) that may be associated with page load times (PLTs). For example, an entry **510** may correspond to a default search engine page (e.g., "www.surch.com", "www.surch.cn"), a home page (e.g., "www.homepage.com"), another document, or any other document not specifically listed (e.g., "default"). Document identifiers to populate entries **510** for a particular client **210** may be extracted, for example, from default search engines, home pages, or other frequently used documents associated with user settings, favorites, and/or a browsing history of browser **215**.

Qualitative speed fields (e.g., low speed field **520**, typical speed field **530**, high speed field **540**) may correspond to performance criteria that can trigger one or more level of optimization for use by client **210**. For example, high speed field **540** may include PLT values (e.g., measured in milliseconds (ms)), associated with each particular entry **510**, that represent a minimum threshold for effective, unrestricted use of full-featured content in browser **215**. Medium speed field **530** may include PLT ranges, associated with each particular entry **510**, that represent a first level of optimization for browser **215**. For example, a first level of optimization may include longer caching periods for documents (e.g., to reduce the frequency of downloads). Low speed field **520** may include PLT values or ranges, associated with each particular entry **510**, that represent a second level of optimization for browser **215**. For example, a second level of optimization may include serving (from server **220** or server **230**) less rich content (e.g., to reduce file size of downloads).

Each of entries **510** may include a different value **550** for each qualitative speed field (e.g., low speed field **520**, medium speed field **530**, high speed field **540**). Thus, for example, a low speed field **520** value corresponding to one entry **510** (e.g., ">2500 ms" for "www.surch.com") may be different than a low speed field **520** value corresponding to another entry **510** (e.g., ">3000 ms" for "www.surch.cn"). Also, values **550** for each speed field may be expressed with discreet numbers (e.g., ">2500 ms") or as percentages of a default value (e.g., "X" for "www.homepage.com"). The value for each qualitative speed field associated with a particular entry **510** may be provided by server **220**/**230** (e.g., as defined by a network administrator) or may be determined by client **210** based on, for example, a test PLT for a document associated with the particular entry **510**.

Although FIG. **5** shows example fields of data structure **500**, in other implementations, data structure **500** may contain fewer fields, different fields, or additional fields than depicted in FIG. **5**. For example, in another implementation, data structure **500** may include a single speed field to define a threshold below which a single level of optimization may be used. Also, while FIG. **5** is described primarily in the context of PLT values, data structure **500** may also be applied to other forms of connection performance data (e.g., processor speed, available RAM, cache evictions, etc.).

FIG. **6** is a block diagram of example functional components of server **220**. The functional blocks, illustrated in FIG. **6**, may be implemented in hardware or a combination of software and hardware on server **220**. For example, the functional components, described in connection with FIG. **6**, may be implemented by one or more of the components depicted in FIG. **3**. While particular functional blocks are shown as being associated with server **220**, any of these functional blocks may be implemented in server **220** or a combination of servers **220/230**. As shown in FIG. **6**, server **220** may include a connection feedback monitor (hereinafter "feedback monitor") **600**, an optimization module **610**, a content format repository **620**, and a quality of connection (QoC) directory **630**.

Feedback monitor **600** may receive connection performance information from client **210** (e.g., from feature manager **430**). In one implementation, feedback monitor **600** may receive a performance indication from client **210** as a quantitative value (e.g., connection performance data, such as a PLT value) associated with a particular document (e.g., a web page). The quantitative value may be, for example, an average value or a most recent PLT value for a particular document. Feedback monitor **600** may receive the PLT data and interpret a qualitative indicator (e.g., low speed, medium speed, high speed, etc.) for client **210** using for example, a data structure similar to data structure **500** described above in connection with FIG. **5**. In another implementation, feedback monitor **600** may receive a connection performance indication from client **210** that already includes a qualitative indicator. The connection performance indication may be received from client **210**, for example, as part of a hyper text transfer protocol HTTP header or a URL parameter. Feedback monitor **600** may provide the qualitative indicator, associated with client **210**, to optimization module **610**. In one implementation, connection feedback monitor **600** may also provide the qualitative indicator, associated with client **210**, to QoC directory **630**.

Optimization module **610** may receive connection performance information from feedback monitor **600** and determine appropriate optimizations. For example, optimization module **610** may receive a qualitative indicator from feedback monitor **600** and identify an appropriate optimization, if necessary. In one implementation, optimization module **610** may have multiple optimization steps associated with multiple quantitative levels of connections. For example, if the connection performance is at an optimal level (e.g., high speed), optimization module **610** may provide full-featured content. If the connection performance is slightly less than an optimal level (e.g., medium speed, rather than high speed), optimization module **610** may increase a cache maximum-age value included in the HTML headers of requested content to reduce subsequent bandwidth usage by client **210**. Increasing the cache maximum-age value may allow browser **215** to use on locally stored content and decrease downloads associated with particular documents. However, if the connection performance is significantly less than an optimal level (e.g., low speed, rather than high or medium speed), optimization module **610** may select a less rich version of content for some documents to be download to client **210** and notify the user of client **210** about the change. For example, optimization module **610** may select (e.g., from content repository **620**) a text-only content format instead of a content format with images and/or videos. In another implementation, optimization module **610** may identify appropriate optimizations based on comparing actual PLT values for benchmark documents (e.g., received from client **210**) to threshold levels associated with the benchmark documents.

Content format repository **620** may include content, templates, high/low bandwidth components, etc., that can be selected (e.g., by optimization module **620**) to provide optimal performance for client **210** based on the qualitative indicator received from connection feedback monitor **600**.

Quality of connection (QoC) directory **630** may include a database that tracks the speed of connections for particular clients **210** and/or locations. In one implementation, QoC directory **630** may be updated (e.g., by feedback monitor **600**) in real time. QoC directory **630** may be made available for applications and services to use to determine a connection performance of a requesting client **210** before providing requested services.

Although FIG. **6** shows example functional components of server **220**, in other implementations, server **220** may contain fewer functional components, different functional components, differently arranged functional components, and/or additional functional components than depicted in FIG. **6**. Alternatively, or additionally, one or more functional components of server **220** may perform one or more other tasks described as being performed by one or more other functional components of server **220**.

Example Processing

FIG. **7** is a flowchart of an example process **700** for optimizing browser performance based on a connection performance. In one implementation, the processing of FIG. **7** may be performed by one or more components within client **210**. In another implementation, the processing of FIG. **7** may be performed by one or more components within server **220** in combination with client **210**.

Process **700** may include determining one or more connection performance values (block **710**). For example, as described above in connection with FIG. **4**, connection quality monitor **420** may measure connection performance indicators for requested documents (e.g., web pages). Connection performance indicators for a client (e.g., client **210**) may include, for example, PLTs, processor speed, available RAM, cache evictions, etc. In one implementation, PLTs may be used as indicators of connection performance. For example, short PLTs may be indicative of fast or adequate connection performance, while longer PLTs (e.g., PLTs greater than a particular threshold) for the same document may be indicative of slower or inadequate connection performance. PLTs may be measured from the perspective of client **210** (e.g., based on timestamps obtained from operating system **400**). Connection quality monitor **420** may, for example, implement a local stopwatch script to detect start times and end times for latency, page-render times, and/or total load time of requested documents (e.g., web pages). In other implementations, connection quality monitor **420** may obtain connection performance information from another component of client **210**, such as another module associated with browser **215**.

Returning to FIG. **7**, process **700** may include identifying whether the determined one or more connection performance values are below a highest value (block **720**). If the determined one or more connection performance values are not below a highest value (block **720**—NO), process **700** may return to block **710** to determine a next connection performance value. If the determined one or more connection performance values are below a highest value (block **720**—YES), the one or more connection performance values and/or an indication of the one or more connection performance values may be sent to a server (block **730**). For example, as described above in connection with FIG. **4**, feature manager **430** may make a local determination of whether the connection performance data and/or the qualitative connection performance indicators are indicative of a need for optimization.

For example, if feature manager **430** determines that the raw connection performance data or the average connection performance data is below a particular speed threshold, feature manager **430** may not send an indication to server **220** or server **230** and may simply continue to monitor future connection performance. If feature manager **430** determines that the raw connection performance data or the average connection performance data is below a particular speed threshold (or within a range for a particular qualitative connection performance indicator), feature manager **430** may send an indication to server **220** and/or server **230** that optimization is required for a high latency/low bandwidth connection. Feature manager **430** may send raw connection performance data, averaged connection performance values, and/or qualitative connection performance indicators to servers **220**/**230**. The connection performance data may be sent using existing communication mechanisms associated with toolbar **410**, such as headers or URL parameters associated with a document request.

Referring back to FIG. **7**, process **700** may include invoking and/or receiving optimized instructions and/or content (block **740**), and notifying a user of optimization settings (block **750**). For example, as described above in connection with FIG. **4**, when feature manager **430** provides an indication to server **220**/**230** that the connection performance for client **210** is not ideal (e.g., below a connection performance threshold or having a low/medium qualitative connection performance indicator), server **220**/**230** may respond with optimized content and/or instructions to make best use of limited bandwidth. Browser **215** may receive the optimized content and/or instructions and seamlessly implement the optimized content. Server **220**/**230** (or a functional component of client **210**) may provide a message for presentation to the user explaining the temporary change. Additionally, or alternatively, server **220** may provide instructions to feature manager **430** to disable particular modules of toolbar **410** based on the current connection performance.

FIG. **8** is a flowchart of an example process **800** for providing optimized browser content based on a connection performance. In one implementation, the processing of FIG. **8** may be performed by one or more components within server **220**/**230**. In another implementation, the processing of FIG. **8** may be performed by one or more components within server **220**/**230** in combination with client **210**.

Process **800** may include receiving a connection performance indication from a client (block **810**). For example, as described above in connection with FIG. **6**, feedback monitor **600** may receive a connection performance information from client **210** (e.g., from feature manager **430**). In one implementation, feedback monitor **600** may receive the performance indication from client **210** as a quantitative value (e.g., a PLT value) associated with a particular document (e.g., a web page) and interpret a qualitative indicator (e.g., low speed, medium speed, high speed, etc.). In another implementation, feedback monitor **600** may receive a connection performance indication from client **210** that already includes a qualitative indicator.

Returning to FIG. **8**, process **800** may include determining if the connection performance is acceptable for full features (block **820**). If the connection performance is acceptable for full features (block **820**—YES), full-featured content/instructions may be sent to the client (block **830**). If the connection performance is not acceptable for full features (block **820**—NO), optimized content/instructions may be sent to the client (block **840**). For example, as described above in connection with FIG. **6**, optimization module **610** may receive a qualitative indicator from feedback monitor **600** and identify an appropriate optimization, if necessary. In one implementation, optimization module **610** may have multiple optimization steps associated with multiple quantitative levels of connections. For example, if the connection performance indication is at an optimal level (e.g., high speed), optimization module **610** may provide full-featured (e.g., rich) content. If the connection performance indication is slightly less than an optimal level (e.g., medium speed, rather than high speed), optimization module **610** may extend a cache maximum-age value included in the HTML headers of requested content to reduce subsequent bandwidth usage by client **210**. However, if the connection performance indication is significantly less than an optimal level (e.g., low speed, rather than high or medium speed), optimization module **610** may select a less rich version of content for some documents to be download to client **210** and notify the user of client **210** about the change. For example, optimization module **610** may select (e.g., from content repository **620**) a text-only content format instead of a content format with images and/or videos.

Returning to FIG. **8**, a QoC directory may be updated (block **850**). For example, as described above in connection with FIG. **6**, QoC directory **630** may be updated (e.g., by feedback monitor **600**) in real time. QoC directory **630** may be made available for applications and services to use to determine a connection performance of a requesting client **210** before providing requested services.

CONCLUSION

Systems and/or methods described herein may implement a browser extension to monitor the performance of a client's network connection. Based on the monitored connection performance, the browser extension may adjust settings of the browser extension to improve performance and/or transmit an indication of the monitored connection performance to servers that provide documents to the client. In one implementation, a client may request and receive, from a server, a document for presentation in the browser associated with the browser extension. The client may calculate one or more connection performance values for the document and may determine that the one or more connection performance values are below a minimum threshold value. The client may send, to a different server, a request for another document, different from the originally-requested document. The request for the other document may include an indication that the one or more connection performance values are below the minimum threshold value, so that the other server may supply the other document in a format best suited for the current network connection performance, as indicated by the connection performance value.

The foregoing description of implementations provides illustration and description, but is not intended to be exhaustive or to limit the invention to the precise form disclosed. Modifications and variations are possible in light of the above teachings or may be acquired from practice of the invention. For example, while series of blocks have been described with regard to FIGS. **7** and **8**, the order of the blocks may be modified in other implementations. Further, non-dependent blocks may be performed in parallel.

It will be apparent that aspects described herein may be implemented in many different forms of software, firmware, and hardware in the implementations illustrated in the figures. The actual software code or specialized control hardware used to implement aspects does not limit the embodiments. Thus, the operation and behavior of the aspects were described without reference to the specific software code—it being understood that software and control hardware can be designed to implement the aspects based on the description herein.

It should be emphasized that the term "comprises/comprising," when used in this specification, is taken to specify the presence of stated features, integers, steps, or components, but does not preclude the presence or addition of one or more other features, integers, steps, components, or groups thereof.

Even though particular combinations of features are recited in the claims and/or disclosed in the specification, these combinations are not intended to limit the disclosure of the invention. In fact, many of these features may be combined in ways not specifically recited in the claims and/or disclosed in the specification. Although each dependent claim listed below may directly depend on only one other claim, the disclosure of the invention includes each dependent claim in combination with every other claim in the claim set.

No element, act, or instruction used in the present application should be construed as critical or essential to the invention unless explicitly described as such. Also, as used herein, the article "a" is intended to include one or more items. Where only one item is intended, the term "one" or similar language is used. Further, the phrase "based on" is intended to mean "based, at least in part, on" unless explicitly stated otherwise.

What is claimed is:

1. A system having one or more server devices, the system comprising:

a memory to store a plurality of instructions; and

a processor to execute instructions in the memory to:

receive, from a client, a request for a particular document, where the request includes a connection performance indication for the client,

the connection performance indication including one or more of:

a page load time (PLT) value of the particular document for the client;

an average PLT value of the particular document for the client; or

a qualitative indicator of the connection performance based on a PLT value for the client;

determine if the connection performance indication is sufficient for providing full-featured services based on comparing the connection performance indication to a group of defined speeds associated with the particular document,

send, to the client, the particular document with rich content when the connection performance indication is sufficient for providing full-featured services, and

send, to the client, the particular document in an optimized format, including less rich content than the particular document with rich content, when the connection performance indication is not sufficient for providing full-featured services, where the optimized format includes a notification, for presentation to a user of the client, of the optimized format.

2. The system of claim **1**, where, when determining if the connection performance indication is sufficient for providing full-featured services, the processor is configured to:

identify the PLT value and a benchmark document identifier from the connection performance indication,

compare the PLT value to the group of defined speeds for the benchmark document identifier to determine a qualitative connection performance.

3. The system of claim **2**, where the determined qualitative connection performance may correspond to one of multiple levels of optimized formats.

4. The system of claim **1**, where the connection performance indication is included within one of a hyper text transfer protocol (HTTP) header or uniform resource locator (URL) parameter included in the request.

5. A method performed by a client device, comprising:

requesting, by the client device and from a particular server, a document for presentation in a browser associated with the client device;

receiving, by the client device and from the particular server, the document;

calculating, by a processor of the client device, one or more connection performance values for the document,

the one or more connection performance values including one or more of:

a page load time (PLT) value of the document for the client device;

an average PLT value of the document for the client device; or

a qualitative indicator of a connection performance based on a PLT value for the client device;

determining, by the processor of the client device, whether the one or more connection performance values are below a threshold value;

sending, by the client device and to another server, a request for another document, for presentation in the browser, where the request for the other document includes an indication of the one or more connection performance values when the one or more connection performance values are below the threshold value;

receiving a first version of the other document when the one or more connection performance values are below the threshold value,

the first version of the other document being determined based on comparing the one or more connection performance values to a group of defined speeds associated with the other document; and

receiving a second version of the other document when the one or more connection performance values are greater than or equal to the threshold value, where the first version includes less rich content than the second version.

6. The method of claim **5**, where the other document includes instructions for the browser based on the indication of whether the one or more connection performance values are below the threshold value.

7. The method of claim **5**, further comprising:

sending, by the client device and to the particular server, an indication that the one or more connection performance values are below the threshold value.

8. The method of claim **5**, further comprising:

adjusting, by the processor of the client device, features associated with the browser or a browser extension, associated with the browser, based on the determining whether the one or more connection performance values are below the threshold value.

9. The method of claim **5**, where calculating the one or more connection performance values for the document includes:

averaging the one or more connection performance values for the document with one or more other connection performance values for other documents.

10. The method of claim **5**, where determining whether the one or more connection performance values are below the threshold value includes:

comparing the one or more connection performance values to a stored value.

11. The method of claim **5**, where the indication is inserted in one or more of:

a hyper text transfer protocol (HTTP) header of a message sent from the client device to the other server, or

a uniform resource locator (URL) parameter for the other document sent from the client device to the other server.

12. The method of claim **5**, where determining whether the one or more connection performance values are below the threshold value includes:

identifying one of multiple quantitative levels of connection performance, below the threshold value, associated with the one or more connection performance values.

13. The method of claim **5**, where the one or more connection performance values for the document include more than one connection performance value, the more than one connection performance value including at least one of:

a domain name server (DNS) lookup time,

a connection latency value,

a processor speed,

an available RAM value, or

a cache eviction value.

14. The method of claim **5**, where sending the request for the other document comprises:

causing, by a browser extension included in the client device, the browser to attach the indication of the one or more connection performance values to the request for the other document.

15. A method performed by one or more server devices, comprising:

receiving, by one of the one or more server devices and from a client, a request for a particular document, where the request includes a connection performance indication for the client,

the connection performance indication including one or more of:

a page load time (PLT) value of the particular document for the client;

an average PLT value of the particular document for the client; or

a qualitative indicator of the connection performance based on a PLT value for the client;

determining, by one of the one or more server devices and in response to the request, if the connection performance indication is sufficient for providing full-featured services based on comparing the connection performance indication to a group of defined speeds associated with the particular document;

sending, by one of the one or more server devices and to the client, the particular document with rich content when the connection performance indication is sufficient for providing full-featured services; and

sending, by one of the one or more server devices and to the client, the particular document in an optimized format when the connection performance indication is not sufficient for providing full-featured services, where the optimized format includes less rich content than the particular document with rich content.

16. The method of claim **15**, where the connection performance indication is included within one of a hyper text transfer protocol (HTTP) header or uniform resource locator (URL) parameter included in the request.

17. The method of claim **15**, further comprising;

storing, in a memory associated with one of the one or more servers, the connection performance indication for the client; and

sending, to the client, a subsequent document in an optimized format based on the stored connection performance indication.

18. The method of claim **15**, where determining if the connection performance indication is sufficient for providing full-featured services comprises:

associating the page load time (PLT) value with a particular document identifier,

comparing the PLT value to the group of defined speeds to determine a qualitative indicator, and

identifying an optimization setting associated with the determined qualitative indicator.

19. A non-transitory computer-readable medium for storing instructions, the instructions comprising:

a plurality of instructions which, when executed by one or more processors associated with a client device, cause the one or more processors to:

calculate a page load time (PLT) value for a document provided to the client device;

determine, based on the PLT value, a qualitative connection performance indicator for the client device;

send, to a server, a request for another document, where the request includes an indication of the qualitative connection performance indicator;

receive a first version of the other document when the qualitative connection performance indicator corresponds to a first connection quality,

the first version of the other document being determined based on comparing the qualitative connection performance indicator to a group of defined speeds associated with the other document; and

receive a second version of the other document when the qualitative connection performance indicator corresponds to a second connection quality, where the first version includes less rich content than the second version.

20. The non-transitory computer-readable medium of claim **19**, where the plurality of instructions further cause the one or more processors to:

adjust features associated with a browser or a browser extension, associated with the browser, based on the qualitative connection performance indicator.

21. The non-transitory computer-readable medium of claim **19**, where the plurality of instructions, when calculating the PLT value, cause the one or more processors to:

determine a particular PLT value associated with a last request for the document, or

determine an average PLT value associated with multiple requests for the document.

22. The non-transitory computer-readable medium of claim **19**, where the document is one of:

a browser home page, or

a default search engine page.

23. A method performed by a client device, comprising:

requesting, by the client device and from a particular server, a document for presentation in a browser associated with the client device;

receiving, by the client device and from the particular server, the document;

calculating, by a processor of the client device, one or more connection performance values for the document,

the one or more connection performance values including one or more of:

a page load time (PLT) value of the document for the client device;

an average PLT value of the document for the client device; or a qualitative indicator of a connection performance based on a PLT value for the client device;

determining, by the processor of the client device, whether the one or more connection performance values are below a threshold value; and

adjusting, by the processor of the client device, features associated with the browser or a browser extension, associated with the browser, based on the determining whether the one or more connection performance values are below the threshold value.

24. The method of claim **23**, where adjusting the features associated with the browser or the browser extension include one or more of:

limiting automated communications, from the client device to the particular server, when the one or more connection performance values are below a threshold value, or

disabling one or more modules of the browser or the browser extension, when the one or more connection performance values are below a threshold value.

25. The method of claim **23**, where calculating the connection performance value for the document includes:

averaging the connection performance value for the document with one or more other connection performance values for other documents.

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